Original Article

A Comparison of Amniotic Fluid Index versus Single Deepest Vertical Pocket Measurement at Term as a Predictor of Adverse Perinatal Outcome

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Abstract

Background: Checking the volume of amniotic fluid (AFV) is an important aspect of assessing foetal well being and for birth management. Several studies have generated conflict concerning the precision of the Amniotic Fluid Index (AFI) and Single Deepest Vertical Pocket (SDVP) sonographic techniques and their ability to predict an unfavourable outcome for babies. These are two of the most commonly reported ultrasound measurements. The purpose of the study is to compare AFI and SDVP at term as predictors for adverse perinatal outcomes in pregnancies managed at Rohilkhand Medical College and Hospital Bareilly. **Material and Methods:** This observational study was prospective in nature and included 150 singleton pregnancies at term in two groups of 75 with one group evaluated using AFI and the other SDVP. Negative perinatal outcomes, such as Apgar score less than 7 at 5 minutes, NICU admission, meconium-stained amniotic fluid, and delivery by caesarean section for foetal distress, were captured. The statistical analyses included chi-square testing, relative risk, sensitivity, specificity and both positive and negative predictive values. **Results:** Oligohydramnios was found in 24% of cases in the AFI group and 12% of cases in the SDVP group ($p<0.05$). The incidence of induction was higher in AFI (42.7% vs. 28.0%), as was the incidence of caesarean delivery (33.3% vs. 20.0%). Further, adverse composite perinatal outcomes were present in 17.3% of cases in the AFI group, and in 12.0% of cases in the SDVP group. Compared to SDVP, AFI had greater sensitivity (77% vs. 56%) but lower specificity (80% vs. 92%). **Conclusion:** The amniotic fluid index (AFI) yields a false positive diagnosis of oligohydramnios that can lead to unnecessary interventions that do not improve infant outcomes. The single deepest vertical pocket (SDVP) is a better and more cost-effective assessment of the anticipated health of a newborn, as it is reliable and easier to interpret overall.

Keywords: Amniotic Fluid Index, Single Deepest Vertical Pocket, Term Pregnancy, Oligohydramnios, Perinatal Outcome.

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Introduction

Amniotic fluid functions as a supportive and protective medium for the growth, development, and continued metabolic activities of the foetus. Amniotic fluid volume (AFV) provides assessments of the function of the foetus's kidneys, ability to swallow, and placental delivery of nutrients. Abnormal AFV can have implications for foetal distress, growth restriction, and poor neonatal outcomes. The assessment of amniotic fluid volume (AFV) by sonographic techniques continues to be an important component of antenatal monitoring practice. In 1987, Phelan et al. introduced the Amniotic Fluid Index (AFI) measurement method,[1] which measures the sum of the four largest vertical pockets within each quadrant of the uterus. In a prior exploration of AFV, Chamberlain et al. developed the Single Deepest Vertical Pocket (SDVP) method in 1984 as a measure of the largest vertical pocket without foetal parts or umbilical cord within the pocket in mind.[2]

Numerous articles have questioned the prominence of these two methods. AFI provides numeracy assessment and has been criticized for diagnosing too many oligohydramnios cases resulting in unnecessary induction of labor and cesarean sections without improved perinatal outcomes.[3-7] On the other hand, WHO and SMFM recommended SDVP which is easier to use and has fewer false positives.[8-10] Since Indian hospitals perform a high number of obstetric procedures, this study wanted to see if AFI or SDVP better predicts poor outcomes for term infants in pregnancies managed at Rohilkhand Medical College and Hospital, Bareilly.

Materials and Methods

Study Design: A prospective observational study will be conducted over 12 months, from January 2024 to January 2025, in the Department of Obstetrics and Gynaecology at Rohilkhand

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Medical College and Hospital, Bareilly.

Sample Size: 150 term (≥37 weeks) singleton pregnancies with cephalic presentation and intact membranes were included. Participants were divided into two groups:

Group A (AFI group): 75 cases measured by AFI

Group B (SDVP group): 75 cases measured by SDVP

Exclusion Criteria: Multiple pregnancies, fetal anomalies, rupture of membranes, placenta previa, and medical disorders like preeclampsia or diabetes.

Measurement Protocol: AFI calculated as the sum of the vertical depths in each of four quadrants.

SDVP recorded as the single deepest pocket ≥2 cm and ≤8 cm.

Measurements were performed by trained sonographers using the same ultrasound machine.

Outcome Measures:

1. Low Apgar score (<7 at 5 min)
2. Meconium-stained liquor
3. NICU admission
4. Caesarean section for fetal distress

Statistical Analysis: Data analyzed using SPSS version 26. Chi-square and Student's t-tests were applied; $p<0.05$ was considered significant. Sensitivity, specificity, PPV, and NPV were calculated for both indices in predicting adverse outcomes.

Results

This table outlines the key characteristics of participants in both groups. There are no significant differences ($p>0.05$) between AFI and SDVP groups on average maternal age and gestational age, and both groups were similarly distributed with regards to parity. There were no significant difference between groups in maternal age, gestational age, or parity. This confirms that randomisation worked, and findings will not be influenced by the mother's age or weight of the infant at birth. Similar baseline characteristics also allow for easier comparison of AFI and SDVP. Similar demographic data indicates that the differences in oligohydramnios assessment and maternal intervention rates are likely a function of the measuring technique, rather than maternal or obstetric differences.

Table 1: Demographic Characteristics

Parameter	AFI Group (n=75)	SDVP Group (n=75)	p-value
Mean maternal age (years)	26.4 ± 3.5	26.1 ± 3.7	0.42
Mean gestational age (weeks)	38.6 ± 1.1	38.5 ± 1.2	0.61
Primigravida (%)	52	49	0.37

Table 2: Distribution of Oligohydramnios and Interventions

Parameter	AFI (%)	SDVP (%)	p-value
Oligohydramnios	24	12	0.048
Induction of labor	42.7	28	0.021
Caesarean section	33.3	20.0	0.030

This table shows how often oligohydramnios was found and how often obstetric interventions were needed in both groups. AFI identified oligohydramnios in 24% of cases, compared to 12% by SDVP, indicating a statistically significant difference ($p=0.048$). The induction and caesarean rates were significantly elevated in the AFI group, at 42.7% and 33.3%, respectively.

Table 3: Neonatal Outcomes

Outcome	AFI Group (%)	SDVP Group (%)	p-value
Low Apgar (<7 at 5 min)	10.7	9.3	0.72
Meconium-stained liquor	14.7	10.7	0.48
NICU admission	17.3	12.0	0.34
Mean duration of NICU stay (days)	3.1 ± 1.2	2.9 ± 1.1	0.56
Neonatal death	1.3	0	0.31

The table presents neonatal results, such as low Apgar scores, meconium-stained amniotic fluid, NICU admissions, and neonatal deaths. The AFI group experienced marginally higher rates of adverse outcomes, with none reaching statistical significance ($p>0.05$). The number of days and duration of NICU admission were similar across both groups. This would suggest that even though AFI diagnosed more oligohydramnios and the need for more intervention, there was no difference between groups with regards to length of stay or neonatal morbidity. The length of NICU stay for both groups was short (less than 4 days), indicating that the newborns were admitted only for observation and/or very minor treatment and were not admitted for any serious medical issues. AFI found more cases of oligohydramnios; however, this is not a predictor of poor outcomes for the newborns. This further emphasizes that increased intervention after AFI diagnosis does not lead to better perinatal outcomes. The fact that SDVP is just as effective for newborns proves that it is a reliable method of monitoring babies in utero.

Table 4: Diagnostic Performance

Index	Senstivity	Specificity	PPV	NPV
AFI	77%	80%	54%	92%
SDVP	56%	92%	64%	89%

This table illustrates the effectiveness of both indices in predicting negative outcomes for a fetus or mother during pregnancy. The amniotic fluid index is very sensitive, identifying most real instances of oligohydramnios, but it will also identify a greater number of instances that will ultimately prove to be untrue positives in (i.e., it is confirmatory). The SDVP, by design, will not identify all true cases of oligohydramnios due to a lower sensitivity; however, its specificity provides a more reliable diagnosis (i.e., it is definitive). In this particular study, the PPV is also higher in the SDVP (64% vs. 54%). However, the NPV for both measures is high, which would suggest any fetus with a normal result is likely to rule out adverse outcomes. In this study, specificity has greater value in lower-risk pregnancies, where the objective is to identify significant cases of oligohydramnios with little morbidity and not unnecessarily find rebellious obstetric cases that add additional risk. Thus, in non-dominant, the SDVP would provide higher specificity resulting in a lower number of births with atypical findings of oligohydramnios.

Discussion

In the past, measuring amniotic fluid volume (AFV) has been a key determinant of foetal well-being, and an important component of obstetric management at term. The Amniotic Fluid Index (AFI) and Single Deepest Vertical Pocket (SDVP) methods, are the two most widely used methods worldwide, yet an evidence base to facilitate a comparison of their predictive ability has yet to be found. This study was conducted at Rohilkhand Medical College & Hospital in the city of Bareilly to provide clarity to the utility of the two sonographic indices to predict the risk of adverse perinatal outcomes in the context of the full-term pregnancy. The conclusions add to the current debate regarding the absolute best means of measuring amniotic fluid volume in routine obstetric practice.

Historical Context and Rationale

In 1987, Phelan et al,[1] were the first to apply the AFI method to assess AFV, which is now the most frequently used method for measuring AFV. To obtain the AFI, the vertical depths of the largest fluid pocket in each of the uterus's four quadrants are summed. The World Health Organisation (WHO),[4,5] and the Society for Maternal-Fetal Medicine (SMFM) suggest the Single Deepest Vertical Pocket (SDVP), or largest vertical pocket of fluid that does not contain foetal parts or umbilical cord. Some do not trust the evidence for the SDVP being easy to use (or not) because they think it should not work as well for identifying oligohydramnios. However, an increasing amount of evidence shows that the AFI's increased sensitivity often results in increased false positives which lead to unhelpful obstetric interventions without improved neonatal outcomes.[6-9]

This study engages in global debate about the outcomes in a real-life tertiary-care setting in northern India. A comparison of 75 cases that were assessed with AFI and SDVP, we attempted to assess the accuracy of each method to determine adverse outcomes while decreasing unnecessary obstetric intervention.

Key Findings and Clinical Correlations

According to our analysis, oligohydramnios was present in 24% of pregnancies using AFI and 12% using SDVP (p=0.048). This is very similar to the findings of Nabhan and Abdelmoula (2009),[6] which indicated a detection and diagnosis of low AFV using AFI approximately twice as often as using SDVP, although this higher diagnosis frequency with AFI did not lead to a decrease in neonatal morbidity. In our case, we showed that 17.3% of the pregnancies with oligohydramnios had composite adverse perinatal outcomes (including low Apgar scores, NICU admissions, meconium-stained liquor, and umbilical artery acidosis) compared to 12.0% of pregnancies with SDVP (p=0.34). There was therefore no statistically significant difference.

This result bolsters the argument that AFI's increased sensitivity does not lead to better perinatal outcomes. Overdiagnosis of oligohydramnios frequently leads to clinical interventions that potentially subject the mother to needless harm, either through unwarranted induction of labour or through a caesarean delivery. The rates of induction in our cohort were significantly higher in the AFI group (42.7% versus 28.0%) and the rates of caesarean deliveries were higher (33.3% versus 20.0%). Gunasingha et al. (2022),[7] and Ezem et al,[8] (2018) noted an increased frequency of interventions that occurred with management protocols that included AFI. They found something like that in their writing.

Diagnostic Value and Predictive Accuracy: The research indicated that AFI had a higher sensitivity (77%) but a lower specificity (80%), while SDVP had lower sensitivity (56%) and greater specificity (92%). This determines the clinical utility. A high-sensitivity test like AFI will not miss too many genuine cases of oligohydramnios but will have many false positives. On the other hand, SDVP has increased specificity meaning there will be fewer false positives, increasing its excellence for confirming genuine oligohydramnios. For a low-risk population, the aim should be to establish specificity to prevent unnecessary actions, especially in light of the relative low risk of any actual foetal compromise at this expulsion level.[10–12] Magann et al,[10] (2011) compared AFI and SDVP for predicting perinatal outcomes and found no increased sensitivity for adverse outcome with AFI; however, SDVP more accurately predicted normal outcome while decreasing unnecessary clinical actions. Our data are consistent with their data in confirming the ability of SDVP to decrease morbidity associated with unnecessary action.

Clinical Implications for Obstetric Management: The implications of these findings are significant for change in clinical practice. The potential for overtreatment due to AFI provoking the diagnosis of oligohydramnios, such as early induction and higher rates of caesarean sections, as well as maternal morbidity from unnecessary interventions, is troubling at best. This is even more tractable in areas like India, where resources to manage the healthcare system are tight. Every unnecessary induction and caesarean section puts a considerable strain on the healthcare system financially and logistically. SDVP use has the potential to prevent these types of interventions while not jeopardizing newborn safety. This is consistent with WHO recommendations that suggest relying more on clinical judgment and care that is personalized instead of depending upon cutoffs.[5,17]

Rohilkhand Medical College & Hospital might function more efficiently, with regards to both patient and resources, value if degree of AFV is measured using SDVP, and the overall number of interventions is reduced. Reducing the rate of false-positive oligohydramnios cases and unnecessary early deliveries would also improve clinician confidence in their care.

Comparison with International Studies: A worldwide review of evidence supports our findings. A Cochrane meta-analysis (2008),[14] established that AFI and SDVP are not interchangeable in predicting "bad outcomes" for the infant, but more inductions of labour and caesarean sections were performed in the AFI group. Thorsell et al,[12] (2012) found that AFI overestimates oligohydramnios and results in performing many unnecessary interventions for the infant. Rosati et al,[13] (2015) and Chauhan et al,[9] (1999) also supported that SDVP has a higher positive predictive value in identifying genuine oligohydramnios. Eddleman et al (2014),[11] thought that AFI was unreliable in predicting foetal distress and perinatal death, which raises questions about the clinical significance of the measurement. We lend support to these findings by reporting that although AFI identifies more cases of "low fluid," those cases do not result in worse conditions for our cohort of newborns. As such, SDVP may be a safer way to protect both the mother and her baby.

Pathophysiological Considerations: The biological basis for assessing AFV is rooted in the dynamic balance of fetal urine production, consumption, and intramembranous absorption. Amniotic fluid volume reaches a plateau at term, and small variations in measurement are not necessarily a problem. The quadrants of AFI may paradoxically rank small changes in fluid pockets higher in significance than they should be, especially as components of the fetus can temporarily displace or obscure pockets due to change of position. The single-pocket assessment used by SDVP reduces this error and provides a clearer indication of AFV.[20] In addition, Magann et al,[15] (2003) showed that AFI and SDVP would frequently classify identical patients differently, with AFI identifying a higher frequency of purported oligohydramnios without clinical derangement. This shows the importance of necessary contextualizing. SDVP limits a focus on small movements of fluid by directing attention to the largest measurable pocket, which should create an appropriately better representation of the fetal environment.

Advantages of the Current Study: The study's strengths include a prospective design, standardized measurement protocols, and defined outcome measures. While the same measurement strategies and clinical decisions were retained by limiting the sample to one tertiary-care hospital site. The relevance of the study findings in similar clinical settings is particularly significant in India, given the ongoing prevalence of inappropriate interventions. Furthermore, the analysis was strengthened by including a range of neonatal outcomes including Apgar scores, NICU and umbilical cord pH. The trends showing reproduction of patterns across these parameters, suggested that delivery after increased detection of oligohydramnios with AFI would not improve neonatal safety.

Limitations and Considerations

While there are limitations to this study, it does provide important findings. First, while the sample size was adequate to allow early comparisons, it may not be sufficiently powered to detect the rare adverse outcomes such as perinatal mortality or potentially severe acidosis. Future larger multicentric studies would help validate these findings. Second, while randomisation alleviated some biases, blinding was not feasible with either the sonographers or the treating clinicians, and performance bias may have occurred. Another limitation was the absence of Doppler studies that could have added to the overall understanding of placental function including foetal blood flow. The combination of SDVP monitoring in conjunction with Doppler indices including the umbilical artery and middle cerebral artery resistance indices would further increase the accuracy of foetal monitoring and would provide better thresholds for intervention.

Integration with Guidelines and Policy Implications

The findings of this study are consistent with the SMFM Consult Series #46 and the ACOG Practice Bulletin (2018),[4,18] both of which recommend using SDVP instead of AFI in low-risk pregnancies to minimize unnecessary obstetric interventions. The RCOG Green-top Guidelines No. 31,[17] also supports a personalised assessment saying that AFI cut-offs should not be the only way to identify oligohydramnios.

These recommendations mean that to make practice more standardised and facilitate evidence-informed decision-making, SDVP could be added to national and institutional protocols. Such an approach has the potential to greatly reduce the number of unnecessary inductions, caesarean sections, and the length of hospital stays in India where there is a limited number of doctors and resources.

Implications for Future Research: Prospective studies should work toward determining SDVP cutoff values specific for populations since factors such as maternal hydration, body composition, and ethnicity may impact amniotic fluid distribution in individuals. Fusing SDVP measurement with biophysical profile (BPP) assessment and Doppler velocimetry may increase diagnostic precision even further. Longitudinal studies examining AMV measures during late pregnancy may aid in distinguishing transient versus persistent oligohydramnios enhancing timing decisions regarding delivery. Economic evaluations of AFI and SDVP directed management may give policymakers useful information regarding cost-effectiveness in low- and middle-income countries.

Theoretical Interpretation of Results: The contrast between AFI and SDVP in detecting oligohydramnios reveals that both use different measurement methods. AFI aims to assess the total volume of amniotic fluid available throughout the world, whilst SDVP measures the largest available fluid pocket usable by the foetus. As explained by Poon et al. (2016) [20], AFI can experience dis-proportionality due to summation error from small variations in localised pockets of amniotic fluid volume, whereas SDVP's single point observational measure reduces cumulative observational error. Therefore, the low specificity of SDVP was likely attributed to its reduced sensitivity to small but still impactful spatial variations in distribution. In our study, we found that in the normal term pregnancy indicated by equilibrium

with foetal urine production and consumption, SDVP better identifies real pathological reduction of AFV. This suggests that SDVP is more physiologically valid, in terms of being a safe and effective diagnostic measure.

Broader Context: Maternal and Neonatal Outcomes: When considering the situation from a different angle, obstetric interventions in the HI stakeholders are closely intertwined with the safety of mother and perinatal outcomes. Overreliance on AFI to make obstetric decisions could lead to greater risk of unnecessary iatrogenic preterm births, incurring postoperative morbidity and psychological trauma. On the other hand, utilizing SDVP as the default index could provide mothers with more options, by potentially reducing unnecessary interventions and/or facilitating spontaneous labour. Exceeding the individual patient outcomes in our study, there is public health implications. With limited health care resources available, if obstetrical interventions are minimised and even slightly reduced, the healthcare costs, length of stay in hospital, and NICU resource use could be improved. The findings of this study are likely to be meaningful in relation to individual obstetrical care, but also related to the/outcomes of obstetrical patient care in general.

Conclusion

In summary, this study provides substantial local evidence reaffirming the increasing agreement that SDVP is preferable to AFI for assessing the amniotic fluid at term. The data demonstrates that AFI misdiagnoses oligohydramnios frequently, leading to higher induction and caesarean delivery rates, with no improvement in neonatal outcomes. SDVP is logically the preferred method for estimating AFV in full-term pregnancies due to its superior accuracy and ease of execution.

Incorporation of SDVP into routine antenatal surveillance procedures at Rohilkhand Medical College, and similar healthcare facilities, will develop evidence-based obstetric practice, decrease unnecessary interventions, and improve maternal-fetal outcome. Future research and updates to national guidelines must correlate to national standardization of use and to retain fetal surveillance approaches that are scientifically sound and suitable for use in 21st-century obstetric practice.

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Conflicts of interest

There are no conflicts of interest.

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